

$$\frac{62}{69} = 89.8$$

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Name

Medical Microbiology Exam—Bacteriology Block May 11, 2001

Instructions:

1. Fill in name and count pages—there should be X questions.
2. Read questions carefully-- format varies.
3. For multiple matching format, read through **all** the choices in order to pick the one that best, i.e., most specifically, fits each statement.

Short answer section. (Total of 29 points)

1. (2 pts.) Name a critical characteristic that can be used to generally distinguish a pathogen from a non-pathogen.

-2 Secretion of exotoxin; although not all bacteria are toxigenic, those that do produce a toxin are likely to be pathogenic

2. (3 pts.) A. Define ID_{50} , i.e., infectious dose 50 (1 pt.). The dose/inoculum required to produce infection in half of a given number of subjects
B. Define LD_{50} , i.e., lethal dose 50 (1 pt.). the dose/inoculum (people, animals, etc) required to produce death in half of a given number of subjects
C. Pathogen A has an ID_{50} of 10 and LD_{50} of 100,000; Pathogen B has an ID_{50} of 1000 and LD_{50} of 10,000. Which is more infectious? (1 pt.) Pathogen A (its ID_{50} is smaller than that of Pathogen B)
3. (6 pts.) Group A strep is considered "suppurative", or pus-forming.
A. Does this organism induce a strong inflammatory response? (1 pt.) yes - pus suggests presence of an immune response
B. What does pus consist of? (2 pts.) mostly dead PMN's and some bacteria
C. This pathogen is associated with two nonsuppurative sequelae, i.e., clinical manifestations that can occur after bacteria are killed. Identify one of them. (1 pt.) acute glomerulonephritis

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4. (10 pts.) *Legionella pneumophila* and *Mycobacterium tuberculosis*. Both of these microbes cause lung infection. Compare them with regards to the following aspects:

A. The primary mode of acquisition of the bacterium by individuals. (2 pts.)

inhalation of infected aerosol droplets in both cases; the difference is that *L. pneumophila* is not spread through person-to-person contact whereas *MTB* is (*Legionella* only from environment).

B. The particular type of host cell that is critical for the initial establishment of an infectious niche. (2 pts.)

both infect alveolar macrophages of the lungs

C. The ability to cause chronic infection. (2 pts.) *MTB* causes chronic infection more commonly than *L. pneumophila*; it is usually contained by the body in granulomas which can later become reactivated. This isn't the case for *Legionella*.

D. The ability to spread within the host. (2 pts.) *Legionella* spreads by growing to large enough numbers to lyse Mφ; *MTB* grows very slowly, but can enter the blood and spread hematogenously; so *MTB* spreads further in the host than *L. pneumophila*.

E. The ability to spread from one human to another. (2 pts.) humans are a dead-end host for *Legionella*; typically does only *MTB* can be spread by aerosols to other humans.

5. (4 pts.) *Neisseria gonorrhea* (i.e., gonococcus) and *Treponema pallidum* (i.e., the syphilis spirochete). These are both important sexually transmitted pathogens that can cause chronic infection. Compare them with regards to the following aspects:

A. The ability to trigger an inflammatory response. (2 pts.) *Neisseria* produces an immune response that accounts for vaginal discharge observed; *Treponema* presents only a few lipoprotein antigens, which makes its immune response weaker and allows for chronic infection.

B. The relative propensity to cause systemic disease. (2 pts.) *Gonococcus* can cause systemic disease by seeding bloodstream (for example, in infected women experiencing meningitis); this is uncommon relative to syphilis; *Treponema* produce secondary syphilis by gaining access to the blood; they are systemic in infection almost always if untreated.

6. (6 pts.) Enterohemorrhagic *E. coli* (EHEC) O157:H7 and *Shigella*.

A. What characteristic shared by both EHEC and *Shigella dysenteriae* gives both organisms the potential to cause hemolytic-uremic syndrome (HUS). (2 pts.)

Shiga-toxin

B. How does the oral infectious dose for *Shigella* and EHEC compare with that for *Salmonella*? (2 pts.) smaller infectious dose needed for EHEC and *Shigella* (~200 bacteria) to cause disease as compared to *Salmonella*.

C. What is responsible for the disparity? (2 pts.)

-2 Shiga-toxin is an enzyme; since enzymes can be recycled, a single molecule (in theory) would be enough to disable protein synthesis in a cell. Therefore, a smaller inoculum is sufficient to produce disease. 2

Multiple choice section. (Total of 38 points.)

Read questions carefully-- format varies.

For multiple matching format, read through **all** the choices in order to pick the one that **best**, i.e., **most specifically**, fits each statement.

Questions 7 - 13. Pick from the list of choices given below the one that **best** fits each statement. Each answer may be used once, more than once, or not at all.

- A. *Borrelia burgdorferi*.
- B. Enterohemorrhagic *E. coli* (EHEC) O157:H7
- C. Enteropathogenic *E. coli* (EPEC)
- D. *Legionella pneumophila*.
- E. *Neisseria meningitidis*
- F. *Vibrio cholerae*
- G. *Clostridium difficile*
- H. *Listeria monocytogenes*
- I. *Neisseria gonorrhoeae*

- 7. Polysaccharide capsule of this bacterium is antiphagocytic. **E**
- 8. The most common cause of hospital-acquired diarrheal infection. **G**
- 9. This bacterium makes an A-B toxin that ADP ribosylates a G protein in the host cell. **F**
- 10. This intracellular pathogen breaks out of the phagosome and grows free in the cytoplasm. **H**
- 11. This bacterium is typically acquired via respiratory secretions. **E**
- 12. This bacterium causes systemic illness by growing to high concentrations in the blood. **E**
- 13. Infection by this organism is often divided into primary, secondary, and tertiary (or chronic) phases, with signs and symptoms that can come and go (i.e., a waxing and waning clinical picture). **A**

Questions 14 - 25. Pick from the list of choices given below the one that best fits each statement. Each answer may be used once, more than once, or not at all.

- A. *Haemophilis influenzae*, type b.

- B. *Streptococcus pneumoniae*
- C. Both.
- D. Neither.

14. High level bacteremia by this bacterium precedes meningitis. C
15. Young children approximately aged 6 months to 2 years are particularly susceptible to invasive disease by this organism because of their relative inability to generate T-independent antibody responses. A C

Questions 16 - 25. Pick from the list of choices given below the one that best fits each statement. Each answer may be used once, more than once, or not at all.

- A. *Vibrio cholerae*
- B. *Mycobacterium tuberculosis*
- C. *Mycoplasma pneumoniae*
- D. *Neisseria meningitidis*
- E. *Bacteroides fragilis*, an anaerobe that contributes to polymicrobial anaerobic infection.
- F. *Treponema pallidum*, the agent of syphilis
- G. *Clostridium difficile*
- H. *Clostridium tetani*
- I. *Clostridium botulinum*

16. Two of the species above typically cause diarrhea. Which of these produces a toxin that damages the physical integrity of the intestinal epithelium? **G** (produces lecithinase)
17. Several of the species above form spores that are difficult to kill. Which makes spores that are responsible for a high rate of nosocomial (hospital-acquired) infection? **G**
18. Two of the organisms above produce potent neurotoxins. Which makes a toxin that acts primarily on peripheral nerves? **I**
19. Cell-mediated immunity is well documented to be critical for control of which of the above organisms? **B**
20. This organism can cause chronic infection in part by constantly altering the antigenicity of its surface. **F**
21. This organism, which has two membranes, can cause chronic infection in part by presenting very few antigenic targets on its surface. **F**
22. This epithelial pathogen does not possess a cell wall. **C**
23. Foul-smelling gas is a clinical hallmark of infection by this organism. **E**
24. Which of the organisms above produces a life-threatening disease that can be successfully treated by fluid replacement? **A**
25. Which of the organisms above produces "walking pneumonia", i.e., a relatively mild lung infection that only rarely requires hospitalization? **C**

Questions 26 - 29. Pick from the list of choices given below the one that best fits each statement. Each answer may be used once, more than once, or not at all.

- A. *Shigella sonnei*
- B. *Shigella dysenteriae*
- C. Enterotoxogenic *E. coli* (ETEC)
- D. Enteropathogenic *E. coli* (EPEC)
- E. Enterohemorrhagic *E. coli* (EHEC O157:H7)
- F. Enteroinvasive *E. coli* (EIEC)
- G. *Listeria monocytogenes*
- H. *Salmonella typhi*
- I. *Salmonella typhimurium*

26. Which of the intracellular pathogens listed above has a propensity to cause disease in pregnant women due to their weakened cytotoxic T-cell response? **G**
27. Which of the *E. coli* listed above produce a cholera-like toxin that causes watery diarrhea? **C**
28. Which of the above can establish a persistent infection of the gall bladder, making the infected individual a chronic carrier who can shed the organism for years. **H**
29. Which of the organisms listed above has been responsible for outbreaks of serious disease acquired for contaminated hamburger in the U.S.? **E**

Questions 30 - 33. Pick from the list of choices given below the one that best fits each statement. Each answer may be used once, more than once, or not at all.

- A. Cholera toxin
- B. Tetanus toxin
- C. Botulinum toxin
- D. Lipopolysaccharide
- E. Streptococcal toxic shock syndrome toxin
- F. M protein
- G. Listeriolysin O
- H. IgA protease

30. Which of the above plays a key role in inducing shock and fever during Gram-negative sepsis? **D**
31. Which of the proteins above also causes host cell to produce large amounts of the cytokines associated with shock? **D**
32. Which of the above binds to MHC and specific V β chains of the T cell receptor? **E**
33. Which of the proteins listed above directly inhibits phagocytosis? **F**

Questions 34 - 44. Pick from the list of choices given below the one that best fits each statement. Each answer may be used once, more than once, or not at all.

- A. *Mycobacterium tuberculosis*
- B. *Neisseria meningitidis*
- C. Both
- D. Neither

- 34. Antibody plays critical role in clearance. B
- 35. Infection may be asymptomatic. C
- 36. Cell wall confers resistant to drying. A
- 37. Can be visualized by gram staining. B
- 38. Disease typically shows indolent (slow) progression. A